

In collaboration with
Accenture and EPRI



Transitioning Industrial Clusters

ANNUAL REPORT
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Foreword



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Accelerating impact at scale

The Transitioning Industrial Clusters towards Net Zero initiative today is a community of 20 signatory clusters across 10 countries on four continents, representing a potential for carbon dioxide-equivalent (CO₂e) emissions reduction of 626 million tonnes. This is comparable to the annual emissions of a country like Australia. The signatory clusters make a direct contribution of \$362 billion to gross domestic product and create or protect 3.4 million jobs.*

In 2023, we welcomed three new signatory cluster members to the community – **DKarbonation** in France, **Louisiana Future Energy Cluster** in the United States (US) and **Tianjin Economic-Technological Development Area** in China.

Industrial clusters and regional collaboration are increasingly more prominent on the agenda of governments and companies seeking to advance energy transition infrastructure and investments. Our signatory community, including partner organizations and corporates, plays an important role in building a decarbonized and competitive global supply chain for essential goods and materials – as solutions providers and suppliers, and as off-takers and demand centres for low-carbon solutions and goods.

This report presents our community of signatory clusters and highlights the progress made towards our vision and ambitions across the four pillars of the initiative – partnerships, policy, technology and finance. The theme of this report is “Financing the Transition”, and it contains a feature on financing industrial clusters that explores case studies of three European signatory clusters. The feature examines the role of clusters in de-risking transition financing, with a review of key considerations in governance, trust, risk mitigation and financing.

We thank all community members, policy-makers and corporate leaders for their time and contributions to this report.

*Represents CO₂e emissions, jobs and GDP/economic data reported by a limited number of signatory clusters. Work is underway to develop a comparable methodology for signatory industrial clusters to report on CO₂e emissions, jobs and GDP.



Executive summary

Governments and companies across the world are mobilizing collaboration in industrial clusters to accelerate the net-zero transition.

Industrial clusters are the building blocks of industrial decarbonization and regional competitiveness. Many geographies are seeing an increase in public-private partnerships and cross-industry collaboration to catalyse the development of decarbonization infrastructure. This is essential to support the net-zero transition journey of industrial clusters locally and in the wider region, while at the same time creating jobs and spurring economic growth.

In Asia, significant efforts are afoot to build supply chains that support higher levels of electrification in the energy systems of the future, centred around e-mobility and battery energy storage. Three signatories of the initiative, **Ordos-Envision Net Zero**

Industrial Park and **Sanjiang New Area Industrial Park** (led by CATL) in China and **the Indo-Pacific Net-zero Battery-Materials Consortium** in Indonesia, are driving efforts to support the scaling of battery energy storage powered by low-carbon energy sources.

In parallel, export-oriented industrial clusters are adopting more sustainable practices in their operations, driven by a host of considerations such as 1) a need to secure future competitiveness of the industrial cluster, 2) the necessity to create and maintain an operating environment attuned to meeting the environment, social and governance (ESG) needs of investors, as well as 3) EU regulations coming into effect to create more scrutiny on environmental and social aspects of products.

For example, the **Jababeka Net Zero Industrial Cluster**, a leading manufacturing hub that contributes significantly to the economy of the West Java province in Indonesia, is proactively pursuing its decarbonization ambitions on multiple fronts. Since joining the initiative at the end of 2022, the cluster has developed its decarbonization roadmap, and formalized partnerships for the development of shared infrastructure to enhance the circularity of industrial solid waste and for wastewater management.

In the US, the Infrastructure Investment and Jobs Act (IIJA) and the Inflation Reduction Act (IRA) are providing a significant boost to the development of decarbonization infrastructure in industrial clusters or hubs. The Department of Energy (DOE) is providing \$7 billion to support the development of seven clean hydrogen hubs across the US. Two clusters from the Transitioning Industrial Clusters initiative community, the **H2Houston Hub** and the **Ohio Clean Hydrogen Hub Alliance**, are anticipated to [benefit](#) from this funding.

In Europe, efforts are on to transform and prepare industry for the energy transition with renewed focus on energy security. Growing cross-border collaboration between European countries is enabling the development of carbon transport and storage infrastructure and hydrogen infrastructure. For example, the **Port of Antwerp-Bruges**, one of Europe's largest integrated chemicals clusters, is working towards the final investment decision (FID) of [Kairos@C](#) and [Antwerp@C](#) to build shared infrastructure for cross-border carbon transport and storage. At the same time, the port is developing a low-carbon hydrogen value chain.

Despite the progress and increasing momentum globally towards industrial decarbonization, significant challenges remain. Industrial decarbonization should be pursued collectively across sectors and industries with due respect to the local context of each geography and market. Among the top challenges:

- Continued efforts are needed to address policies that could hinder the decarbonization of industrial clusters; one example is policy frameworks for cross-border collaboration in shared infrastructure.
- Finance must be unlocked to support deployment and scaling of technology.
- Alignment is needed on fit-for-purpose governance models that can significantly influence how a single cluster or group of clusters could effectively navigate its unique circumstances and requirements to support the achievements of individual corporate net-zero ambitions.
- Partnerships and collaboration between clusters must be strengthened to create synergies.
- Permitting processes need to be accelerated and streamlined.

A diverse and global community

Since the launch of the initiative, the signatory community has grown to 20 industrial clusters spanning 10 countries covering a diversity of industries; 17 are port-anchored industrial clusters.



Planning: Public announcement has been issued, but no collaborative physical asset improvement or construction has begun.



Developing: Collaborative physical asset improvement or construction has begun but is not yet facilitating decreased- or avoided-emissions operations.



Scaling: Decreased- or avoided-emissions operations are occurring as a result of clean technology integration through collaborative measures.



Port-anchored industrial clusters

Port-anchored clusters are defined as industrial clusters with port activity in the near vicinity or linked to cluster activity.

*Cikarang Dry Port

 [Click here to switch between views](#)

Three new signatory port-anchored industrial clusters



Select the tabs
to discover more

*Million tonnes

**All currency conversions are as of 4 January 2024

Progress made by signatory clusters in 2023

The Transitioning Industrial Clusters initiative's approach focuses on four key areas – partnerships, policy, finance and technology, which are fundamental to accelerating an industrial cluster's net-zero transition.



Select the tabs
to discover more



① Partnerships

Catalyse cluster partnerships

Convening cluster partners and aligning on a shared vision requires a carefully managed collaboration between potential partners. The initiative's tested framework is imparted at a three-part workshop series that prompts participants to consider key questions, supported with examples, case studies and participation from the community.

– Vision and Alignment workshop

- Who are the core partners that will take the lead to shape the vision?
- What is the collective vision and ambition for the cluster, including system value benefits that the cluster would deliver?

– Cluster Governance and Stakeholder Engagement workshop

- What will be the governance model and roles of each partner?
- What are the resources that each partner is willing to commit?
- How might momentum be built for the initiative and the coalition strengthened?

– Scoping workshop

- What are the priority anchor projects for the cluster?
- What does the project development roadmap look like for the cluster?

Through these workshops, the initiative has helped many signatory clusters to accelerate their formation and rapidly align among partners on the next steps for the clusters' transition to net zero.



Port of Antwerp.

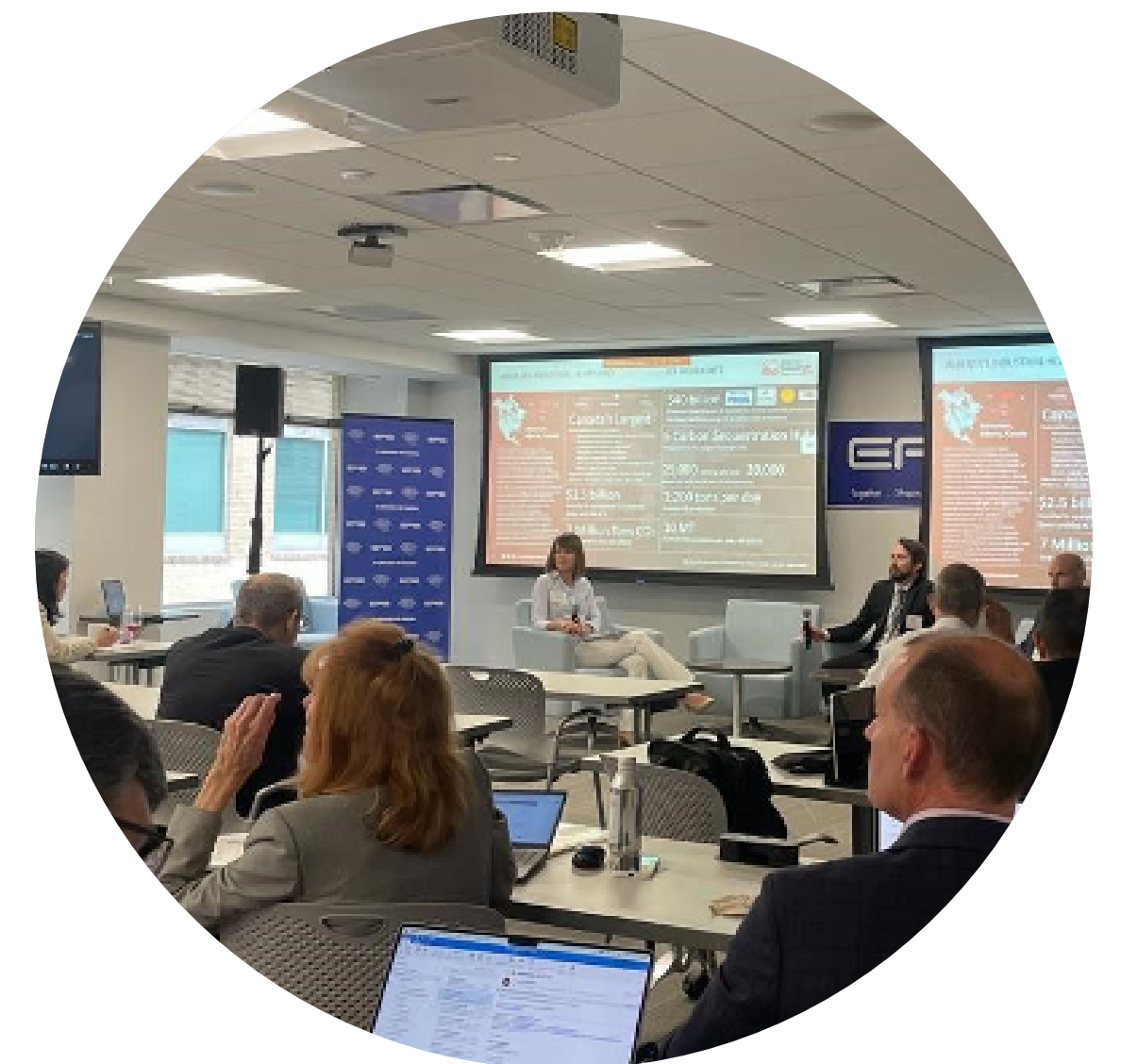


Facilitating dialogue with policy-makers

In 2023, the initiative hosted two in-person events, which included multilateral roundtable discussions between clusters' signatories and policy-makers.

- **April 2023:** Global Community Meeting at Port of Antwerp-Bruges
 - 80+ in-person and virtual participants including industrial clusters, key corporates and policy-makers.
 - Focused on policy and partnerships to enable faster decarbonization of clusters.
 - Participants shared experiences, best practices, approaches, decarbonization strategies, technologies and policies for public-private collaboration.
- **June 2023:** North America Regional Community Meeting in Washington DC
 - 60+ in-person participants from industry, government, policy-makers, non-profits and community groups.

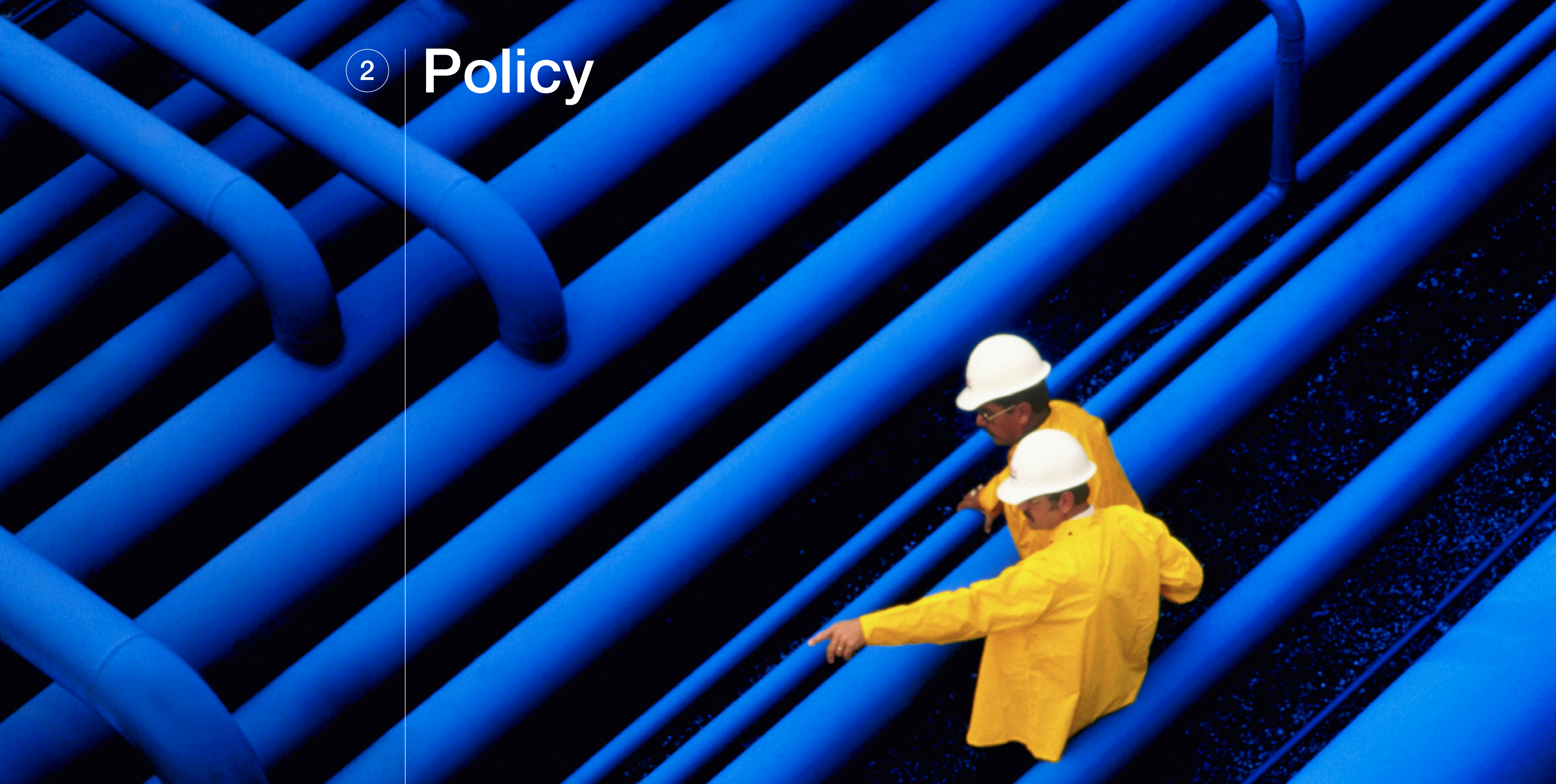
- Focused on regional policy and partnerships for cluster development and decarbonization.
- Discussions included incentives as drivers for decarbonization in US policy, best practices for leveraging resources for net zero by 2050, and collaboration across industry and government.



➤ North America Regional Community Meeting in Washington DC in June 2023.

2

Policy



2 Policy

The initiative published the [second volume of its white paper on the National Policy Enablement for Industrial Decarbonization](#) in November 2023, in conjunction with COP28.

The paper examined policy support for industrial decarbonization through key technologies such as hydrogen, CCUS, systemic efficiency plus circularity, direct electrification and renewable heat. Some key observations:

- Significant importance and impact of comprehensive policy frameworks and fiscal incentives such as the **US Inflation Reduction Act** and **EU Green Deal** in accelerating industrial decarbonization.
- Noticeable trend towards promoting renewable energy sources. Governments are seeking a balanced transition with emphasis on improving energy security.
- Prioritization of renewables reflected in funding allocation relative to other decarbonization solutions.
- Growing momentum in CCUS and blue/green hydrogen in a significant number of countries.
- Carbon pricing gaining prominence in emerging markets; significant gaps between price of carbon in the EU and emerging markets.

 Click to access

 [Country analysed in 2022 Vol I](#)  [Country analysed in 2023 Vol II](#)





US Inflation Reduction Act

- Passed in August 2022, the IRA supports clean energy technology, infrastructure and jobs through federal funding – combining **tax incentives, loans and investment programmes**.
- Includes clean energy production tax credits that can be stacked to enable decarbonization initiatives for hubs and industrial clusters.
- Investment of \$369 billion into energy security and climate change mitigation over 10 years.

European Green Deal

- Announced in December 2019 for a sustainable energy transition, to support economic development and propel climate neutrality by 2050.
- Funded by €600 billion (\$656.9 billion as of 4 Jan, 2024) of the NextGenerationEU recovery plan and from the budget of the EU. Includes initiatives such as the Fit for 55 package, REPowerEU and the Green Deal Industrial Plan.
- Under the Green Deal Industrial Plan, the proposed Net Zero Industry (NZI) Act includes the goal and strategy to bolster European production of net-zero technologies to meet or exceed 40% of needs by 2030.

Source: “Building a Clean Energy Economy”, [The White House](#); “Summary: The Inflation Reduction Act of 2022”, [United States Senate](#); *Enabling Measures Roadmap for Renewable Hydrogen*, [World Economic Forum in collaboration with Accenture](#); European Green Deal, [Council of the European Union](#); The European Green Deal, [European Commission](#); “Net-Zero Industry Act: Making the EU the home of clean technologies manufacturing and green jobs”, [European Commission](#), 22 March, 2023.

3

Technology

3 Technology

No single technology or decarbonization lever will abate all industrial emissions – it is necessary that a spectrum of technology levers, applied within a holistic value approach, work in tandem to optimize emissions reduction measures and the resulting economic, social and environmental value.

The initiative continues to facilitate the sharing of best practices for deployment of decarbonization solutions among signatories as well as other initiatives of the Centre for Energy and Materials.

Source: “Achieving net-zero future with industrial clusters”, [Accenture](#), 1 March 2021; “How Energy Efficiency Will Power Net Zero Climate Goals”, [IEA](#); “Net Zero Roadmap”, [IEA](#); Accelerating Clean Hydrogen Initiative, [World Economic Forum](#).

*Tera-watts

**Gigatons

Accelerating clean hydrogen

Published and updated hydrogen enabling measures roadmap for key markets:

- Europe: updated July 2023.
- Japan: updated July 2023.
- China: launched June 2023 during the Annual Meeting of the New Champions.

Expansion into the Middle East and North Africa (MENA)

- The initiative launched the MENA Hydrogen Roadmap in December.

Clean power for industry

- Expanding the toolbox of approaches regarding energy procurement and change of consumption and electrification, such as 24x7 demand flexibility and response.
- Supporting transitioning from captive to grid power and exploring models for shared power and related infrastructure.
- Regional focus: China.

The diverse community of signatory clusters is deploying decarbonization across the four solution areas:

Systemic efficiency and circularity

In South-East Asia, the **Jababeka Net-Zero Industrial Cluster**, one of Indonesia’s largest industrial estates, is taking forward its plans for shared waste and wastewater management facilities for its 1,800+ industrial tenants.

Direct electrification and renewable heat

In China, the **Tianjin Economic-Technological Development Area (TEDA)** has implemented a geothermal-well heat supply project to cut CO₂ emissions by 5,000 ton/year. Current solar PV power generation capacity is 556 megawatts (MW) and continues to expand.

CCUS

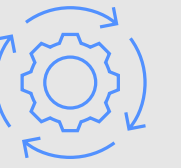
In the UK, **HyNet NorthWest** has announced five carbon capture and hydrogen projects that will remove ~3 million tonnes of CO₂ each year.

Hydrogen

In Europe, **Net-Zero Basque Industrial Super Cluster**’s first electrolyser (2.5 MW) in the Petronor-Repsol refinery commenced green hydrogen production in October 2023.

In the US, a project contributing to a local electrolyser manufacturing hub in **H2Houston Hub** has been announced.

Systemic efficiency and circularity



> 40% of CO₂e abatement by 2040

In IEA’s Sustainable Development Scenario, energy efficiency has a key role in the transition to net zero

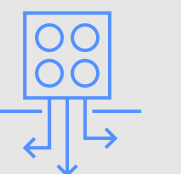
Direct electrification and renewable heat



10 TW* by 2030

Clean power generation has to increase 3x by 2030 and 9x by 2050 – equivalent to an increase in installed capacity from 3 TW to 10 TW by 2030 and 27 TW by 2050

CCUS



1 GT** CO₂ by 2030

Contribution of CCUS required for abating carbon emissions from the energy sector in IEA’s roadmap to net zero

Hydrogen



200 Mt by 2030

To achieve net zero, estimates suggest a need for 200 Mt of clean hydrogen by 2030. This requires a two-fold scale up of production and a shift away from grey hydrogen

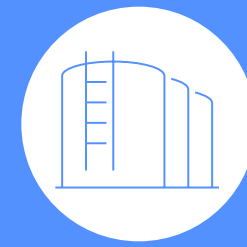
4

Financing

Financing energy transition
projects within industrial clusters
in Europe



Exploring three European industrial clusters



Brightlands
Circular Space



DKarbonation



Andalusian Green
Hydrogen Valley



Research and innovation cluster

This cluster is dedicated to the incubation of technologies and pioneering pre-commercial solutions to address the pressing economic and societal challenge of plastic waste. Brightlands Circular Space's objective is an integral transformation of the existing plastics value chain towards a circular economy. Therefore, the cluster adopts a systemic approach with a collaboration mindset using a new governance model.

Historical cluster

Situated in the historically industrial region of northern France, the cluster revolves around a single player that is a leader in the steel industry. To create an enabling environment that would leverage existing synergies, the DKarbonation cluster is evolving a new governance model where infrastructure and relationships with local authorities are oriented towards a more balanced ecosystem.

Emerging cluster

A relatively recent cluster established in two new locations in southern Spain, this cluster brings together companies from complementary industries with an ambition for extensive energy transformation. While there is a prominent leader, Cepsa, the cluster has the flexibility to design and apply a governance model that secures balanced relationships and fosters growth from the beginning.

Unveiling the distinctive strengths of each industrial cluster

Clusters are navigating the complexities of their respective industries and challenges linked with innovating low-carbon value chains. Insights gained from this study will inform and define the necessary strategies to progress towards net zero.

*GHG emissions data, GDP and jobs creation apply to the Brightlands Chemelot Campus.

	Brightlands Circular Space*	DKarbonation	Andalusian Green Hydrogen Valley
Explored project	Fully circular demonstrator	Carbon capture and storage (CCS)	Green hydrogen production
CO ₂ emissions (yearly)	4 Mt emitted by industry	16 Mt emitted by industry	4 Mt CO ₂ emissions abated
GDP contribution	Industry contributed 20% to gross value added in 2019	\$1.2 billion annual GDP contribution projected by 2050	€3 billion (\$3.3 billion as of 4 Jan 2024) investment for the green hydrogen project
Job impact	3,000 jobs protected 2,000 jobs to be created by 2030	31,950 jobs to be protected and created by 2030-2040	10,000 jobs to be protected and created (1,000 direct)
Skills development	Strong presence of knowledge partners	Reskilling to skill sets for sustainable jobs	High demand for green competencies
Capital investment required	Pre-commercial demonstrator scale	Large scale	Large scale
Main financing sources	Public-private funding	FID expected in second half of 2024 Equity financing supported by EU grant	FID expected by Q1 2024 €3 billion investment from Cepsa
Infrastructure	Proximity of research facilities Potential to share equipment with industrial and knowledge partners (e.g. Chemelot Industrial Park)	Potential to repurpose existing infrastructure for CO ₂ collection and transport Ongoing feasibility studies in the port	Optimal location for solar and wind farms Algeciras port to export hydrogen Huelva hub to develop inland logistics
Governance	Strong involvement of all Brightlands Circular Space partners in governance and communication strategy Focus on enabling innovative systemic approach	Traditional industrial zone establishing a new collaboration model to create CCS value chain and deliver on decarbonization roadmap	Newly formed cluster with a collaborative approach and open communication aimed at leveraging synergies between the renewables and green hydrogen industries

What are the barriers to financing transition projects?

Key insight

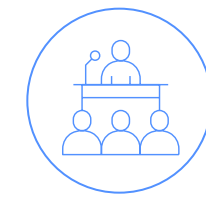
The primary challenges faced by clusters do not revolve exclusively around the project bankability or innovative technology.

Instead, they are rooted in confidence levels, essential governance frameworks and required shifts in business mindsets. Sharing risk among stakeholders and developing risk mitigation mechanisms that facilitate the mobilization of private funding is equally important.



Magnitude of change

Building new value chains (circularity, hydrogen, carbon capture) involves not only deep technological transformation, but also new business models and new money flows, that may be considered disruptive to the status quo and the current paradigm.



Governance

Sustaining effective collaboration throughout the project life cycle may become a challenge in the absence of a well-balanced cluster structure.

The physical distance between corporate headquarters and entities located in the clusters requires well-thought out governance and a proactive approach in influencing decision-makers.



Mindset

A shift in mindset is necessary to embrace innovative public-private capital mobilization and to de-risk solutions for energy technologies and shared infrastructure.



Regulatory framework

Complex regulatory framework including anti-competition law and state aid rules may inhibit swift mobilization of investments for energy transition projects. Navigating the intricate landscape of national policies and regulations poses a hurdle to financing cross-border initiatives.



Trust

Establishing and maintaining trust is pivotal for harmonious and fruitful collaboration not only among the cluster's partners, but also for credibility in relationships between public and private financiers.

Actions to accelerate progress and scale impact

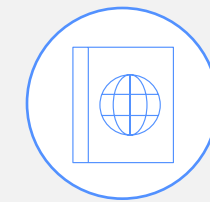


Climate action

Various factors influencing cluster performance highlight the imperative for collective action and collaboration among clusters, policy-makers and financiers.

A shift in mindset to prioritize systemic approaches and long-term goals over short-term profits will be a powerful catalyst.

Increased risk appetite and a grasp of technology and innovation are becoming as critical as traditional de-risking measures, especially as the financial sector has been perceived as a laggard in adapting to a changing world. What is deemed risk-free today might not be tomorrow, necessitating a reconsideration of the status quo.



Policy-makers

Remove administrative hurdles

- Be clearer on funding criteria
- Allow faster decision-making
- Simplify competition law

Value partnership approach

- Promote initiatives addressing comprehensive value chain change

Assist with risk mitigation

- Offer credit enhancement

Stimulate market development

- Incentivize supply and demand
- Taper off existing incentives that may be counterproductive to decarbonization objectives



Financiers

Develop tailored approach

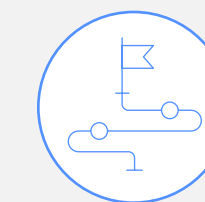
- Customize products and services (long-term finance, less rigorous credit enhancements)

Facilitate collaboration

- Foster collaboration between various investors and government to provide access to grants and incentives

Invest in education

- Enhance skills and internal capabilities to evaluate and appraise technological solutions in the context of the energy transition



Clusters

Encourage resource sharing

- Aggregate demand for efficiency and cost reduction

Engage stakeholders

- Involve local communities to build a positive image for the cluster
- Collaborate with public partners to leverage experience on public funding
- Advocate for favourable policies

Set up an effective communication and governance model

- Maintain a governance model relevant for balanced cluster growth
- Develop strong common branding

Concept for industrial cluster financing

An alternative approach

Conventional financing centred on individual corporates and/or project finance is the most prevalent and cost-efficient means to finance large-scale assets in the examined projects within the focus clusters.

According to investigations by the Transitioning Industrial Clusters towards Net Zero initiative for this financing feature, the industrial clusters with their systemic risk mitigation approach have devised the innovative concept of cluster financing. The main assumption underpinning this perspective is that these clusters operate as legal entities authorized to solicit, obtain and manage financing for a portfolio of projects.

Implementing cluster financing introduces complexities, and most likely the focus on robust revenue streams will remain unchanged, though strategic cluster financing may hold promise for significantly accelerating the transition.

Six strategic questions

- 1 What legal framework would be appropriate for establishing an industrial cluster as a legal entity, considering the need for cluster finance as an umbrella mechanism?
- 2 What governance structure would be most effective for decision-making (e.g. which voting mechanism)?
- 3 How would the financing be structured considering mixed ownership of assets (shared infrastructure) and diverse credit profiles?
- 4 How would liability be distributed?
- 5 What risk management and reporting mechanisms would be established to ensure transparency and accountability?
- 6 What measures should be in place to foster collaboration without violating intellectual property and anti-trust laws?

Potential benefits to investors

- Diversified investment portfolio
- Aggregated reduction of emissions – faster channelling of capital flows into net-zero projects
- Enhanced flexibility in capital structure to accommodate varying risks (options for refinancing)

Potential benefits for clusters

- Potential for optimized debt structures across the cluster and potential use of leverage
- Significant contribution to economic growth with a spillover effect
- Synergies and economies of scale (e.g. certain overhead costs avoided in shared infrastructure projects)

Conclusion

Maintaining momentum and facilitating an orderly transition is critical

The world is in a race against time to decarbonize. The next few years will be essential for governments, corporates and society to work together to lay the essential policy and business foundations for a global transition towards low-carbon energy and industrial infrastructure. It is important to have a fit-for-purpose governance model, tailored to the local context, that can effectively harness the synergies of partnerships within a cluster ecosystem. The policy environment, while at differing levels of maturity around the world, is increasingly attuned to catalysing industrial transformation and creating social and economic uplift through a cluster approach.

For example, in the US, the Investment, Infrastructure and Jobs Act (IIJA) and the Inflation Reduction Act (IRA) have given a boost to the deployment of hydrogen hubs across the country.

In Europe, a broad range of cross-cutting policy measures and funding instruments are in place for industrial emissions reduction such as those under the EU Green Deal, for example the Carbon Border Adjustment Mechanism (CBAM) and the proposed Net-Zero Industry Act.

In emerging markets, meanwhile, plans for implementing carbon pricing have been announced in various geographies such as Japan, Malaysia, Singapore and Thailand. Concepts of net zero and sustainable industry are being positioned as a focus area for industry due to the industrial sector's significance to the local economy such as in Brunei, Malaysia, Singapore and Thailand.

While clusters have many significant challenges to navigate, the ability to unlock financing is essential to scale their impact. With policy support and continued efforts towards cross-sector collaborations, some impact from previous years of effort is starting to show, such as in projects reaching the FID stage and the developments in consortiums working to deploy large-scale shared decarbonization infrastructure. Examples include the progress towards realizing carbon transport and storage projects in the North Sea, in the UK by the East Coast Cluster, and in Belgium at the Port of Antwerp-Bruges.

Despite progress, much more needs to be done to accelerate the transition. To maintain the momentum that has been gained, several key themes must be sufficiently addressed to avoid becoming potential bottlenecks for scaling climate, economic and social impact:



Partnerships

- What actions need to be taken to address the gap in talent for skills in sustainability, low-carbon technologies and new first-of-their-kind facilities? One example is sharing common talent resources across companies within a cluster.
- How can companies effectively harness synergies with ecosystem partners and other industrial clusters, to scale cluster GDP impact and attract investments?



Policy

- What needs to be done to streamline permitting and local regulatory requirements to accelerate deployment of projects?
- What barriers need to be overcome to enable cross-border and cross-industry collaboration?



Technology

- How can key ecosystem stakeholders such as port-anchored clusters establish industry standards for new decarbonization infrastructure?
- How can clusters develop regional roadmaps for technology deployment that optimize affordability and reliability? What is cost effective to deploy in the near term, and how can clusters prepare for the emerging technologies of tomorrow?



Financing

- What considerations are necessary to shift financing instruments towards a cluster approach instead of an individual project approach?
- How can the impact of public funding be maximized to seed and catalyse infrastructure deployment?